slide 1

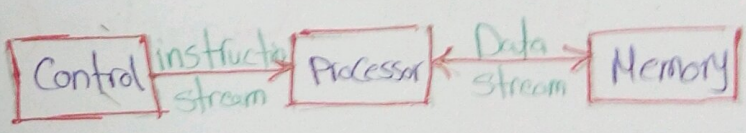
- What is Distributed system definition?

Collection of computers appear as a single computer sharing data and Resources working in Parallel not sequential to perform a single task.

- What is Flynn's taxonomy for computer's Hw

1. SISD (single instruction single data) : one CPU

Perform processes sequentially one at a time and Access Memory N consecutive times to perform sum of N numbers



Speed up solution :

1- Concurrency : Many processes share time of using CPU by Round robin Method

2- Read I/O operations while executing processes simultaneously.

3- divide CPU into Parallel function unit, each one perform specific function at the same time such as Pipelining Approach (Fetch-decode-exec

4-

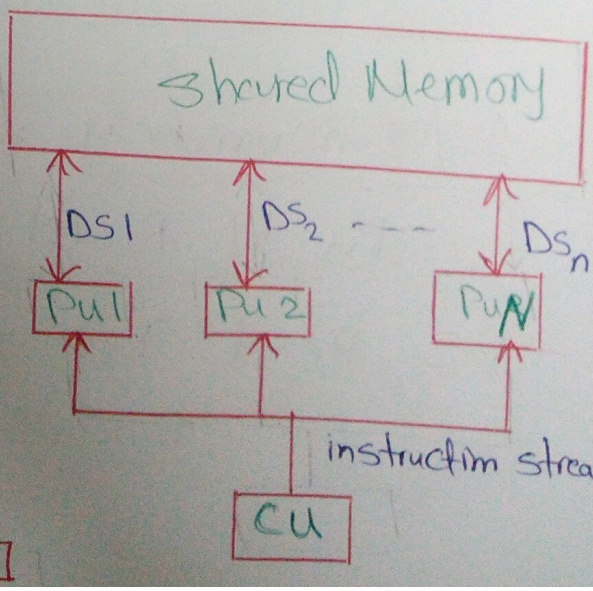
[2] SIMD (single instruction Nultiple Data): (Array or vector processor)

N identical processors named PEs (Processing elements) or slaves under control of a central Control unit, preforming the same instruction (sample or complex) on a different data at the same time then cu produce the final Result such as operations on Matrices.

processor → Active (execute)
processor → inactive (wait)

sharing Data between Processor by two ways

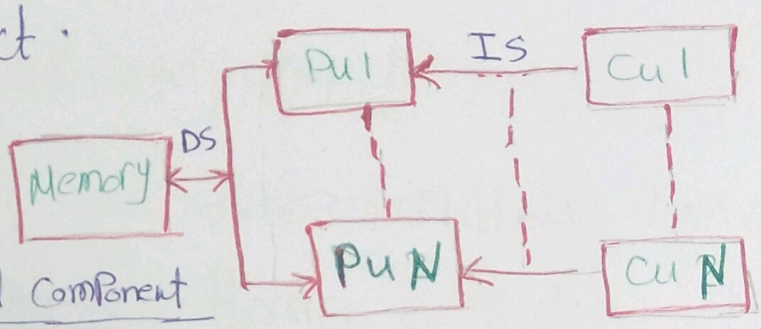
1. shared Memory.
2. shared variables.
3. interConnection Network.



Pu : Processing unit
cu : Control unit

3 MISD (Multiple instruction single Data): (Pipelined Processor).

N of Processors is Performing Sub-Computation in the same task and at the same time sequentially where the output of one stage is the input of the Next.

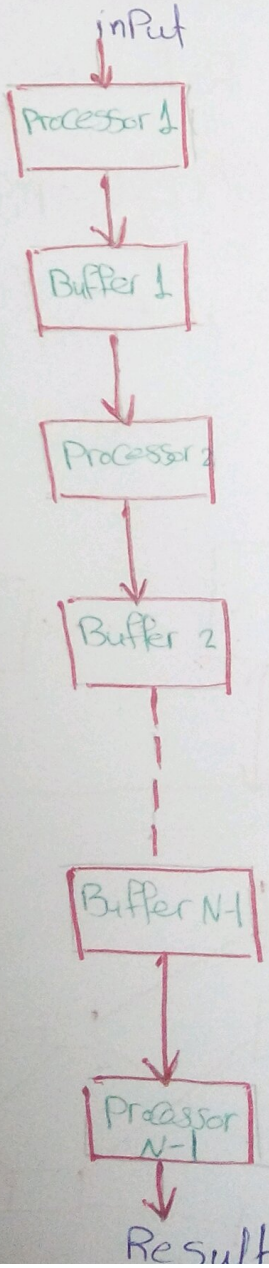


$$\text{speed up} = \frac{\text{time of nonPipelined component}}{\text{time of Pipelined component}}$$

$$= \frac{NM}{N+M-1}$$

N : n. of Data

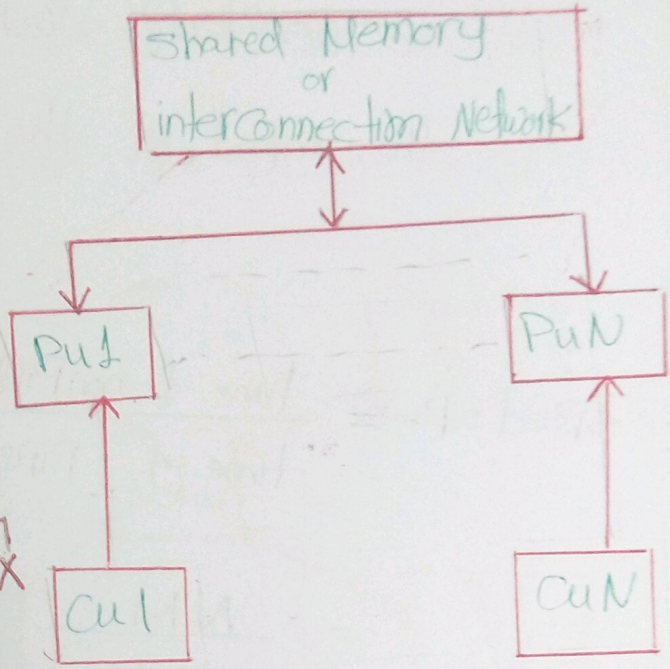
M : n. of stages



[4] MIMD (Multiple instruction Multiple Data):
(Multiple Processor vs Multiple Computer)

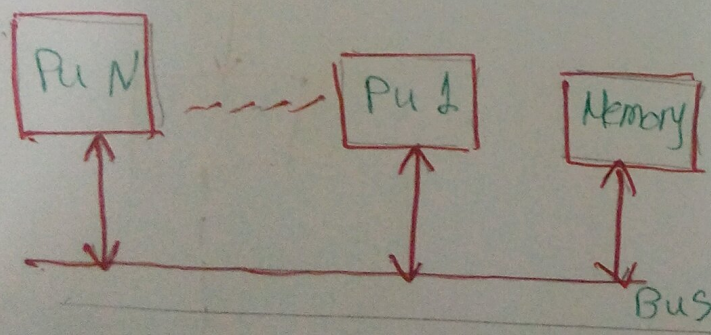
N Processor each one has its own control unit Performing different task on different Data asynchronously

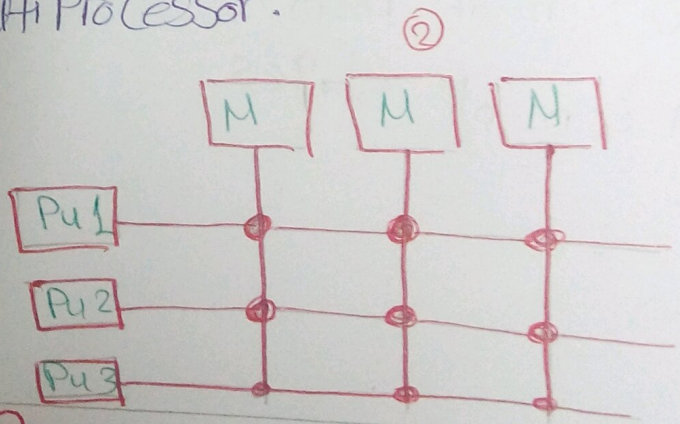
① tightly Coupled Machine called MultiProcessors and its delay is small as the data Rate is high, where they're organized on a single chip (with a single Memory), ex: ① Bus-based MultiProcessor. ② Cross switch ~ . ③ 2 x 2 switch ~ . ④ HyperCube multiProcessor.

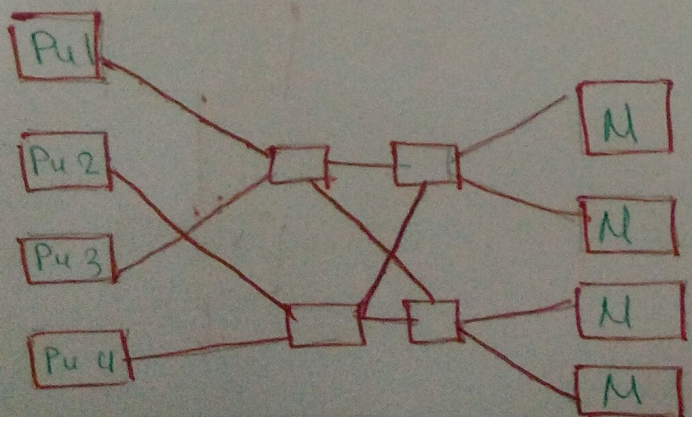


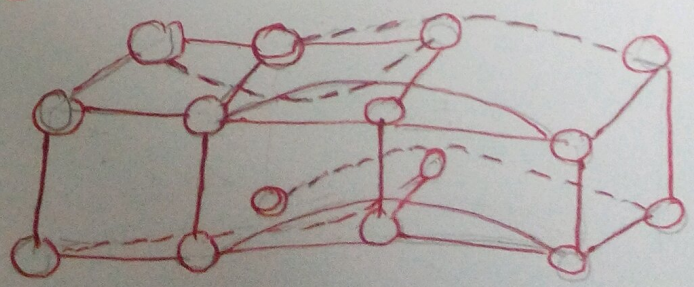
Pu: Processor unit

Cu: Control unit





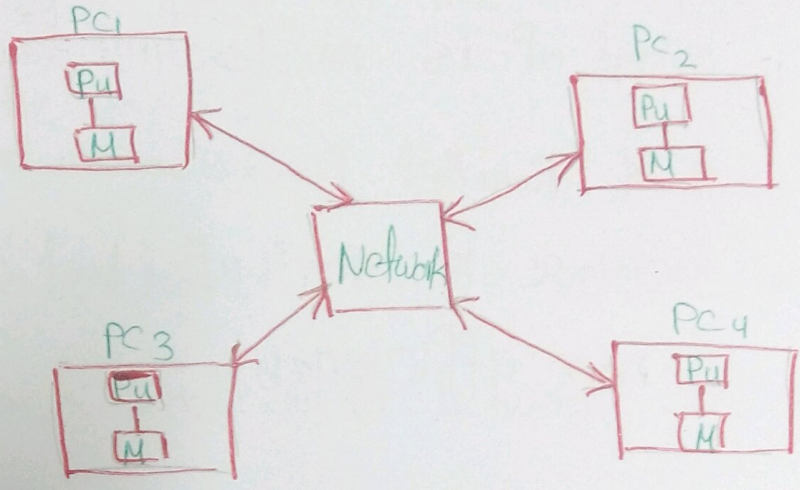




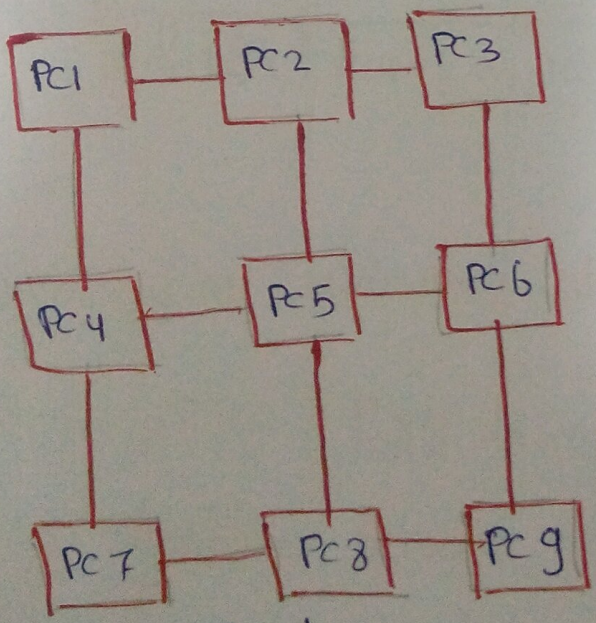
② Loosely-coupled system (distributed system)

called MultiComputers as they are Multiple Computer connected through Network and they Communicate through Message Passing Method thus the data rate is low and the delay is large.

ex: Grid, clusters



"Message Passing Architecture"



Grid

- show difference between speed up and efficiency ?

$$\text{speed up } SN = \frac{\text{time taken by serial algorithm for a process}}{\text{time taken by Parallel algorithm for a process}} = \frac{T_s}{T_p}$$

speed up is misleading factor as we can use n. of Parallel processors more than needed to increase speed up but that's more cost (non efficiency)

so we have to consider another term called

$$\text{efficiency } EN = \frac{\text{speed up}}{\text{n. of Processor in Parallel Algorithm}} = \frac{SN}{N}$$

example : slide 01 → slide num 30

- what are factors limiting speed up in distributed system?

1- Software overhead : Complexity of executing Many code lines in Parallel than sequentially.

2- Load Balancing : we have to consider the speed of the slowest Node in the system to synchronize the tasks.

3- Communication overhead : time spend to send data Back and forth between Processors.

- whate are the advantages of distributed system?

1- Performance : using a collection of Processors rather than centralized mainframe.

2- Distribution Nature of environment such as Banks.

3- Reliability (fault tolerance) : the system survive if one Machine become down (Hw redundancy)

4- incremental growth: we can add new Machines. (openness)

5- sharing data or Resources

- whate are the disadvantages of distributed system?

1- developing difficulties: different os and programming Languages

2- Network Problems: such as overLoading

3- security Problem: data security

- what are distributed system characteristics?

the previous mentioned advantages +

6- TransParency: hide all unnecessary details from users such as:
- Location transParency: doesn't know Hw Location of Accessed Resources
- Migration trasParency: if the server is Moved from its Location
- Replication transParency: if we add new Backup files
- failure transParency: if failure happens

sLide 2

- what are ₤ interProcessor Communication Methods?
  1- shared Memory
  2- shared Variables
  3- Interconnection Network.

- illustrate How Communication is done using shared Memory?

if Processor x wishes to Pass a number to Processor y, he writes it on the shared Memory at Accessible Location to Processor y, then Processor y reads it.

- What are shared Memory issues having to be handled?

that is simulataneous Accessing at the same memory Location, where if P_1 and P_2 Access memory Location X simultaneously so the value of X will be determined by the Last Processor write its value (Non-Determinancy).

- What are the subclasses of the shared Memory Computers ?

[1] Exclusive Read, Exclusive write (EREW):

~~Multiple~~ multiple processors allowed to Read and write simultaneously at the same memory Location.

[2] Concurrent Read, Exclusive write (CREW):

multiple processors allowed to Read the same Location simultaneously but the writing is exclusive.

[3] Exclusive Read, Concurrent write (ERCW):

Multiple Computers allowed to write at the same Location simultaneously but the reading is exclusive.

[4] Concurrent Read, Concurrent write (CRCW):

both Multiple Read and write are allowed at the same Location simultaneously.

- Mention the ways of Resolving write conflicts in Shared Memory Processors ?

1- Assign Priorities to each Processor and accept the value of the highest priority Processor.

2- take the max / min / average of all their values.

- if we are using Shared Memory Processor to search for value index in a List, compare between different Shared Memory subclasses ?

Subclass	time for reading x for All Processor	time for searching for x	time to checks Processer return value	overall
EREW	$o(N)$	$o(n/N)$	$o(N)$	$o(N)+o(n/N)$
ERCW	$o(N)$	$o(n/N)$	Constant	$o(N)+o(n/N)$
CREW	Constant	$o(n/N)$	$o(N)$	$o(N)+o(n/N)$
CRCW	Constant	$o(n/N)$	Constant	$o(n/N)$

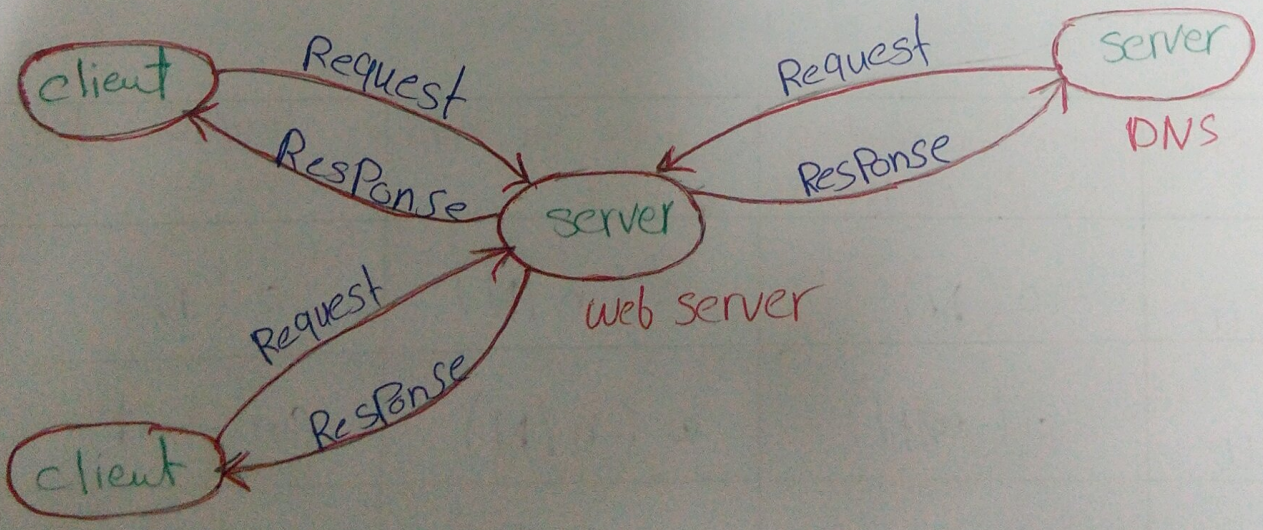
- How do Processor Communicate in the interconnection Network?

- using Message Passing of instructions such as send, Receive functions.

- what are Architectural Model of Multi Computers?

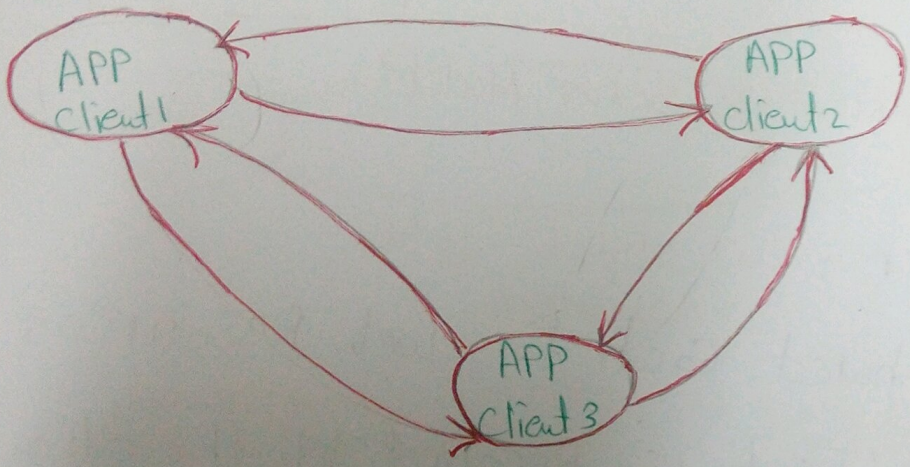
[1] client - server Model :

- the server is a single Machine responds to client Request for a service.
- the client invoke the server service using client interface



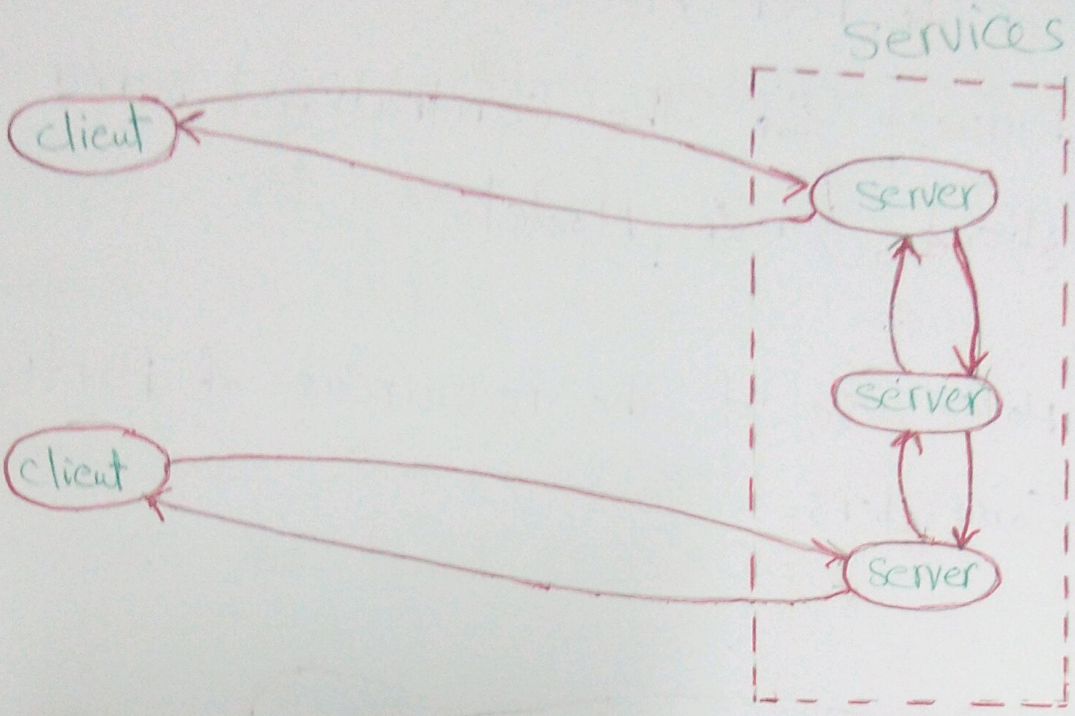
[2] Peer to Peer Model : • avoid the overload Request for the centralized server in the client - Server Model.

• Make use of the resources of Participating Computers.



[3] Multiple Server :

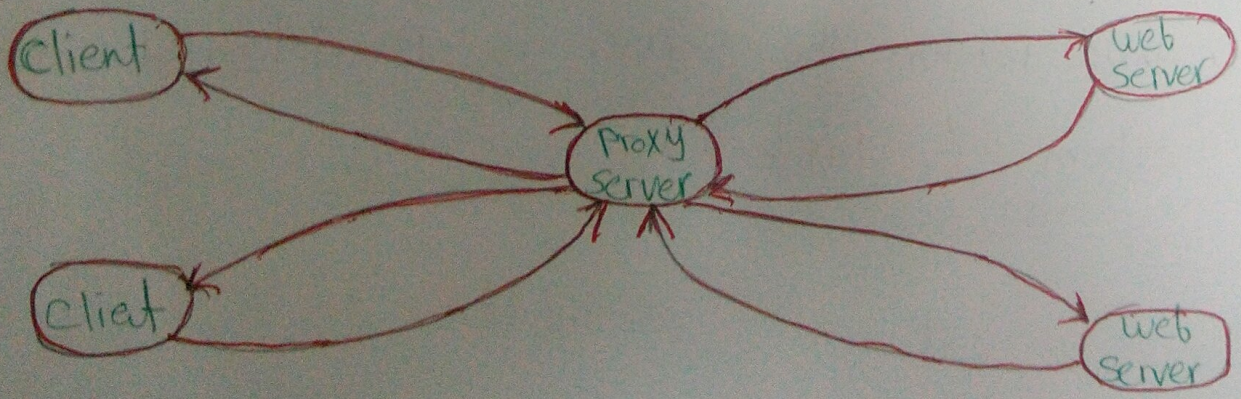
• having Multiple server to introduce a Service where each on having a Replicated data to Load Balance or ~~dis~~ for a disaster Recovery , ~~they Partition~~ the service is Partitioned among them (clusters).



"Multiple Server Model"

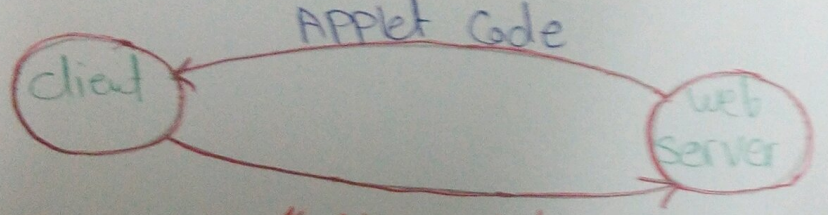
[4] Proxy Server :

it's a shared cach for web Resources, if new object is Received by the client, it's added to the Cache so Next time it will be fetched from Proxy if it is up-to-date otherwise will Request it from the server and Reducing WAN Load.



5 Mobile Code :

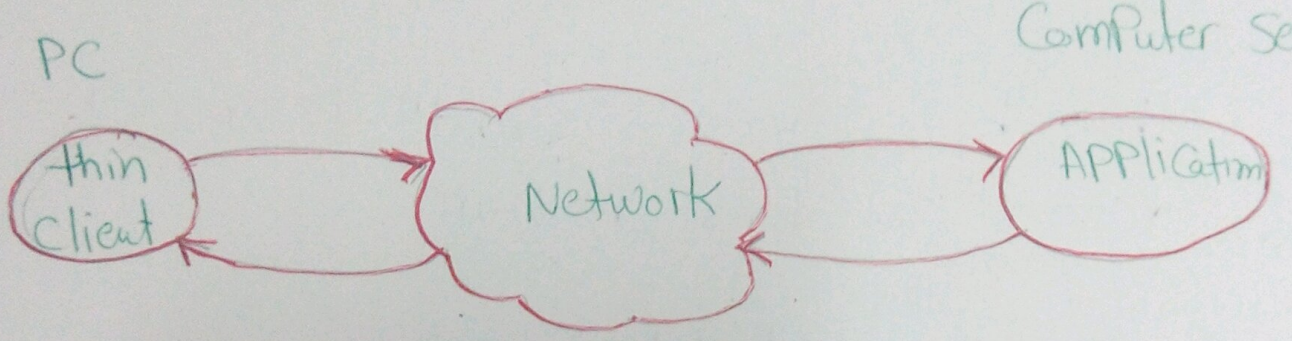
- instead of sending data to code at the server get the code on the client to reduce the delay such as up-to-date notifications
- they have some security issues to limit access for Local resources



" No mobile code approach "

" Mobil code approach "

6 thin client

- the app user have user-interface on his thin computer for the app but all processes are executed on computer server with powerful capabilities through Networks.

- the disadvantage : the delay required in the Network if the sended data is highly graphical activities.